



QUANTUM DOTS SERVE AS THE **BUILDING BLOCKS** OF NEXT-GENERATION MATERIALS

THE IMPETUS

Mathematicians have long been interested in the ways in which shapes pack against one another to fill a three-dimensional volume. In a new experiment, scientists observed the packing behavior of truncated tetrahedral quantum dots.

The assembly of uniform nanocrystal building blocks into well-ordered superstructures is a fundamental strategy for the generation of meso- and macroscale metamaterials with emergent nanoscopic functionalities. Using self-assembly methods, scientists at the Center for Nanoscale Materials (CNM), a U.S. Department of Energy Office of Science user facility located at Argonne National Laboratory, with collaborators from Brown University, Cornell University and Germany (the Max Planck Institute and Heinrich Pette Institute in Leibniz, and Institute for Experimental Virology in Hamburg), produced and observed single-component tetrahedral building blocks in three distinct complex superstructures, including a one-dimensional chiral tetrahelix.

THE WORK

Using techniques in real and reciprocal spaces, scientists successfully characterized the superstructures from their nanocrystal translational orderings down to the atomic-orientation alignments of individual quantum dots.

The superstructures were created by drop-casting a solution of truncated tetrahedral quantum dots in hexane onto a transmission electron microscopy grid placed on a silicon wafer. The truncated tetrahedral quantum dots in solution self-assembled into one, two and three dimensions with one common structural feature: preferred facet-to-facet alignment.

Scanning transmission electron microscopy (STEM) and STEM-energy dispersive X-ray spectroscopy mapping were performed at CNM.

THE IMPACT

The observations expand the collection of superstructures that can use tetrahedral building blocks. The findings also bring the spontaneous formation of nanocrystal assemblies to a higher level of complexity, including chirality in some cases.

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